LACTIPLANTIBACILLUS PLANTARUM 24-7 INOCULATED ALFALFA SILAGE ALLEVIATES SUBCLINICAL MASTITIS IN DAIRY GOATS THROUGH INFLAMMATION SUPPRESSION AND BLOOD-MILK BARRIER ENHANCEMENT

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ABSTRACT

Subclinical mastitis (SM), a prevalent yet often overlooked inflammatory disease, requires urgent attention. Building on our prior finding that feeding *Lactiplantibacillus plantarum* 24-7 inoculated alfalfa silage reduces systemic inflammation and may thus aid in SM prevention, this study further examined the underlying mechanisms. In the SM + Lp 24-7 group, inoculation markedly lowered milk fat, protein, casein, and free fatty acid content, while elevating ruminal acetate, propionate, and butyrate. Somatic cell counts decreased by over 30% on average compared to the SM group during the observation period. Furthermore, the SM + Lp 24-7 group showed increased serum levels of glutathione peroxidase (GSH-Px), total antioxidant capacity (T-AOC), ZO-1, and Occludin, along with reduced pro-inflammatory cytokines (TNF-α, IL-1β, IL-6). Collectively, these results indicate that *L. plantarum* 24-7 feed helps prevent SM through two complementary mechanisms: mitigating inflammatory responses and strengthening blood-milk barrier integrity, supporting its potential as a dietary strategy for maintaining dairy goat health.

Keywords: Subclinical mastitis, *Lactiplantibacillus plantarum* 24-7, somatic cell

INTRODUCTION

Subclinical mastitis (SM) poses a major challenge to the global dairy industry, causing significant economic losses, while conventional antibiotic use raises concerns about antimicrobial resistance. Previous research suggests that alfalfa silage inoculated with *Lactiplantibacillus plantarum* 24-7 (*L. plantarum* 24-7) may reduce mastitis risk through immunomodulatory effects, though its specific mechanisms remain unclear (Zhang *et al*., 2024). Although lactic acid bacteria-fermented feeds are known to benefit ruminant health (Li *et al*., 2022), their targeted efficacy against SM is not well established. This study, therefore investigated the effects and mechanisms of *L. plantarum* 24-7 fermented feed in an SM goat model, aiming to support the development of sustainable prevention strategies.

MATERIAL AND METHODS

Thirty dairy goats with SM were randomly divided into two groups: the SM+Lp 24-7 group (55.5% alfalfa silage containing *L. plantarum* 24-7 + 27.8% concentrate + 16.7% hay, with somatic cell counts (SCC) >500,000/mL) and the SM group (the same proportion of silage without inoculant, with SCC >500,000/mL). Additionally, 15 healthy goats served as the control group (Con group, SCC < 200,000/mL, same silage ratio without inoculant). The experiment lasted 80 days (15-day adaptation period + 60-day treatment period + 5-day sampling period). Serum inflammatory indicators were detected using ELISA kits. Significant mean differences between dietary treatments were separated using Tukey's honestly significant difference (HSD) test at a 5% probability level.

RESULTS AND DISCUSSION

Characteristics of Rumen Fermentation and Milk Quality in Dairy Goats

Feeding with L. plantarum 24-7 inoculated alfalfa silage significantly increased rumen acetate, propionate, and butyrate levels in dairy goats, indicating that this feed effectively promoted fiber degradation efficiency and energy conversion efficiency (Chai *et al*., 2023). Furthermore, the study found that milk protein and casein content were significantly reduced in the SM+24-7 group, suggesting that

Tab. 1: Effects of 24-7 silage on rumen fermentation and milk quality in dairy goats

Items	Dietary treatments			SEM	*P*-value
	Con	SM	SM+Lp 24-7		
Ruminal fermentation					
Acetate, mmol/L	43.6a	18.9c	27.1b	1.07	<0.001
Propionate, mmol/L	8.76a	5.03b	5.49b	0.233	<0.001
Butyrate, mmol/L	7.67a	4.69c	5.84b	0.125	<0.001
Milk composition					
Milk yield, kg/d	1.87a	1.32b	1.43b	0.319	<0.001
Fat, %	6.11b	7.39a	5.54b	0.183	0.001
Protein, %	4.30b	5.44a	4.57b	0.086	<0.001
Casein, %	3.37b	4.25a	3.36b	0.079	<0.001
Milk FFA, %	0.54c	1.74a	0.49c	0.03	<0.001

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this treatment may help maintain mammary gland health by inhibiting protein leakage into milk caused by impaired blood-milk barrier function (Gao *et al*., 2020).

Somatic Cell Count in Dairy Goats, Serum Antioxidant, and Inflammatory Changes

After feeding the *L. plantarum* 24-7 silage, somatic cell counts in dairy goats decreased by 36.8%, 30.6%, 29.6%, 27.8%, and 39.3% at days 7, 14, 30, 45, and 60, respectively (Figure 1A). It significantly elevated serum GSH-Px and T-AOC levels while reducing IL-1β, TNF-α, and IL-6 levels (Figure 1B). Concurrently, it markedly increased ZO-1 and Occludin levels (Figure 1C), indicating that this silage prevents SM by reducing systemic inflammation and maintaining normal blood-milk barrier function.

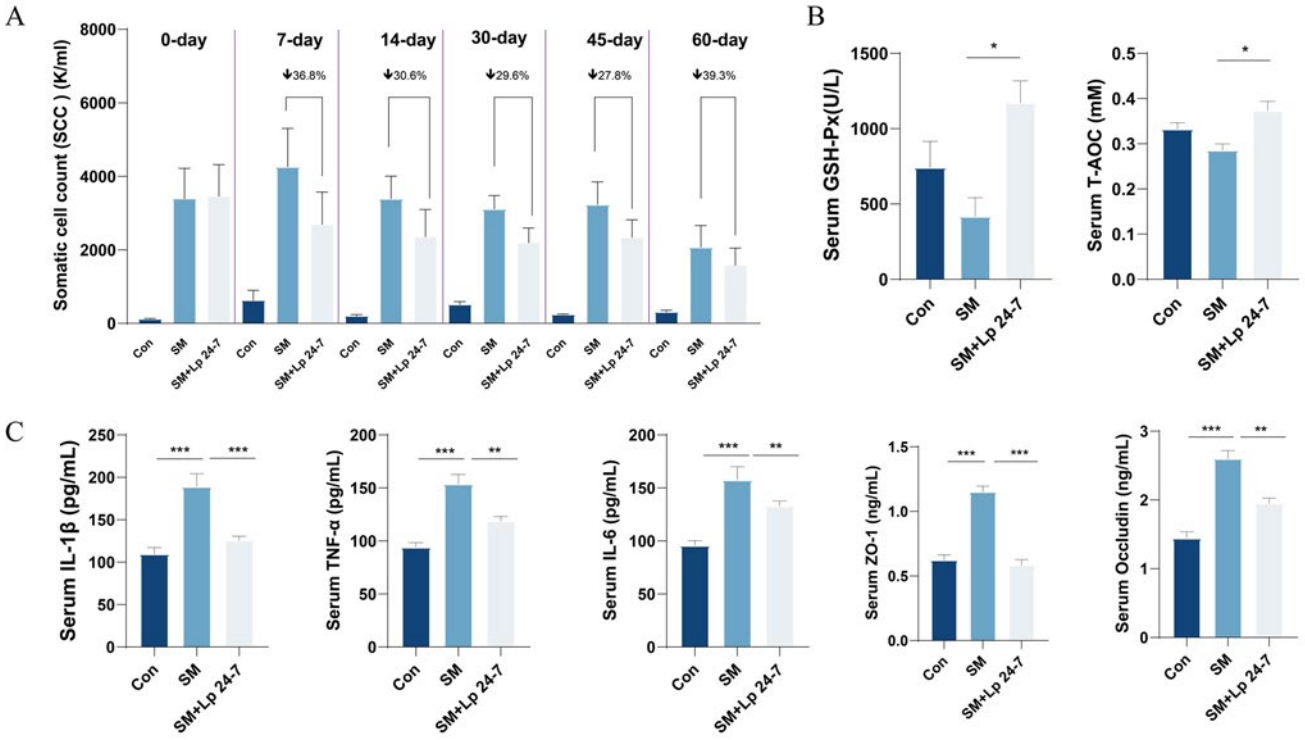

Fig. 1: Effects of 24-7 inoculated feed on SCC, inflammation, and tight junction proteins in dairy goat

CONCLUSION

Feeding dairy goats with *L. plantarum* 24-7 inoculated silage can effectively prevent SM by alleviating systemic inflammatory responses and enhancing the integrity of the blood-milk barrier. This intervention significantly reduced SCC in milk, improved the composition of ruminal volatile fatty acids, and influenced milk composition. These findings indicate that *L. plantarum* 24-7 may serve as a potential strategy for regulating host immune function and barrier health through nutritional intervention, thereby contributing to mastitis prevention and offering new insights for dairy goat health management.

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